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Request for grant of a patent

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2.	Patent application number *(The Patent Office will fill in this part)*	0220685.2 05 SEP 2002
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	**Innogy plc** **Windmill Hill Business Park** **Whitehill Way** **Swindon** **Wiltshire SN5 6PB** **GB**
	Patents ADP number *(if you know it)*	8110777001
	If the applicant is a corporate body, give the country/state of its incorporation	**GB**
4.	Title of the invention	**A cylinder for an internal combustion engine**
5.	Name of your agent *(if you have one)*	**BOULT WADE TENNANT**
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	**VERULAM GARDENS** **70 GRAY'S INN ROAD** **LONDON WC1X 8BT**
	Patents ADP number *(if you know it)*	**42001**

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number (if you know it)	Date of filing *(day/month/year)*
-	-	-

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? **Yes**
(Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
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See note (d))

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Continuation sheets of this form	-
Description	5
Claim(s)	2 CF
Abstract	-
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10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(Please specify)*	

11 I/We request the grant of a patent on the basis of this application.

Signature	Date
	5 September 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Martyn J. Draper
020 7430 7500

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DUPLICATE

A CYLINDER FOR AN INTERNAL COMBUSTION ENGINE

The present invention relates to a cylinder for an internal combustion engine.

In particular, the invention relates to improving the design of a cylinder where there will be high heat transfer to the liner wall. The cylinder liner will be cooled by a flow of coolant. The liner needs to have enough thickness and strength to resist the internal pressures and other mechanical forces, but the thickness is limited both by local temperatures and temperature gradients within the liner, which cause thermal stresses and reduce the fatigue life. The problem of achieving satisfactory cooling while maintaining adequate strength and fatigue life is greatest at the top of the liner because the local heat fluxes are highest. It is also difficult to fit in cooling channels very close to the junction between the cylinder liner and the flame-plate at the top of the cylinder.

It is common to insert a ring of suitable metal at the top of the cylinder to scrape carbon off the piston as it reaches top dead centre. This metal ring can also act as a thermal barrier, which reduces the local heat flux at the top of the cylinder liner. Further, a composite ceramic sleeve at the top of the liner is disclosed in US 4,921,734.

According to the present invention a cylinder for an internal combustion engine comprises a wall generally forming the cylinder, a coolant passage to provide a flow of coolant around the wall, a metallic ring radially inward of the wall at the upper end of the cylinder, the metallic ring being capable of

withstanding a higher temperature than the wall, and an insulating ring between the metallic ring and the wall extending along at least a part of the length of the metallic ring to provide a thermal barrier to reduce the transfer of heat from the metallic ring to the wall in the vicinity of the insulating ring.

The combination of the metallic ring and insulating ring allows some control of the flow of heat into the wall, such that heat can be directed preferentially into parts of the wall which the coolant reaches to moderate the temperature and thermal stresses towards the top of the liner. Also, by providing an insulating ring between the metallic ring and the wall, the insulating ring itself is protected from the harsh environment within the cylinder. Although insulating materials may be able to withstand higher temperatures than metals, insulating materials are generally much more vulnerable than metals to physical damage and to thermal shock.

The insulating ring may be provided by an air gap, but is more preferably a ceramic. This may be sprayed on to the metallic ring and/or liner. Alternatively, the insulating ring is a ceramic tape which is inserted into an annular gap between the metallic ring and the wall.

The cylinder may be unlined. However, preferably it is lined, in which case the wall comprises an outer portion and a liner, wherein the insulating ring is between the liner and the metallic ring.

It has been found that positioning the insulating ring at any location or locations along the metallic ring provides a reduction in the local heat transfer,

but this does not necessarily reduce the temperatures and thermal stresses in the liner. The optimum performance is achieved by providing the insulating ring towards and preferably at the top end of the metallic ring as this is the location which is most difficult to cool with the coolant. The insulating ring preferably extends for only a relatively short distance from the top of the liner, namely for a distance of less than the thickness of the liner behind the metallic ring and preferably less than half the thickness of the liner behind the metallic ring.

The metallic ring is preferably made of a high temperature alloy, such as an nickel alloy, e.g. Nimonic. However, less expensive materials may be used if the temperatures allow this.

The metallic ring preferably protrudes slightly into the bore of the cylinder. In this way, it will act as an anti-polishing ring in a conventional manner to remove carbon build up on the piston crown.

For applications to situations involving high heat fluxes to the liner as a whole, the coolant passage is preferably a helical path progressing around the axis of the cylinder, as this maximises the coolant velocity and hence the heat transfer. However, any suitable form of coolant passage may be used in combination with the present invention.

An example of a cylinder constructed in accordance with the present invention will now be described with reference to Fig. 1 which is a cross section through the upper left hand portion of the cylinder and a corresponding portion of a piston.

The cylinder 1 has a cast iron or cast steel

strongback liner 2. The cylinder head (not shown) sits above the cylinder 2 in a conventional manner. A piston 3 shown partially in Fig. 1 with piston rings 4 reciprocates within the cylinder. The piston does not form part of the present invention and will not be described further here.

The cylinder liner 2 is provided with a helical coolant path which transfers coolant liquid along the length of the cylinder.

A metallic ring 6 is inserted into an annular recess at the top of the liner 2. The ring is preferably a high temperature nickel alloy such as Nimonic. The ring protrudes slightly into the bore of the cylinder to act as an anti-polishing ring. The ring can withstand the high temperatures and stresses at the top of the cylinder without risk of distortion. It will be noted from Fig. 1 that the metallic ring 6 is always positioned above the piston rings 4, even at top dead centre.

An insulating ring 7 is inserted into an annular recess in the top of the metallic ring 6 between the metallic ring and the liner 2. The insulating ring is preferably a ceramic such as Superwool paper.

In this position, the insulating ring 7 provides a thermal barrier between the top of the metallic ring 6 and the liner 2. Thus, heat which is transferred from within the cylinder to the metallic ring will be impeded from flowing through the insulating ring 7 into the very top of the liner 2. Instead, the heat is preferentially transferred to the cylinder liner below the insulating ring. This effectively directs heat into a portion of the liner 2 closer to the coolant passage 5 where it can be more readily removed

by the coolant. Detailed finite element calculations show that this design reduces thermal stresses in the liner and improves the fatigue life.

The method of providing an insulating layer behind the metallic ring may also be applied to situations in which there is no liner but the cylinder is instead formed by boring out the engine casting. As in the case of a cylinder liner, the insulating ring is protected from the hot combustion gases by the metallic ring, but the insulating ring in turn reduces the thermal stresses in the casting.

CLAIMS

1. A cylinder for an internal combustion engine, the cylinder comprising a wall generally forming the cylinder, a coolant passage to provide a flow of coolant around the wall, a metallic ring radially inward of the wall at the upper end of the cylinder, the metallic ring being capable of withstanding a higher temperature than the wall, and an insulating ring between the metallic ring and the wall extending along at least a part of the length of the metallic ring to provide a thermal barrier to reduce the transfer of heat from the metallic ring to the wall in the vicinity of the insulating ring.

2. A cylinder according to Claim 1, wherein the insulating ring is ceramic.

3. A cylinder according to Claim 2, wherein in the insulating ring is a ceramic tape.

4. A cylinder according to claim 2, wherein the insulating ring is sprayed onto the metallic ring and/or liner.

5. A cylinder according to any one of the proceeding claims, wherein the insulating ring is positioned at the top end of the metallic ring.

6. A cylinder according to any one of the preceding claims, wherein the wall comprises an outer portion and a liner, wherein the insulating ring is between the liner and the metallic ring.

7. A cylinder according to Claims 5 and 6, wherein the insulating ring extends from the top of the liner for a distance of less than the thickness of

the liner behind the metallic ring.

8. A cylinder according to Claim 7, wherein the insulating ring extends from the top of the liner for a distance of less than half the thickness of the liner behind the metallic ring.

9. A cylinder according to any of the proceeding claims, wherein the metallic ring is a high temperature alloy.

10. A cylinder according to Claim 9, wherein the metallic ring is a nickel alloy.

11. A cylinder according to Claim 10, wherein the metallic ring is Nimonic.

12. A cylinder according any one of the proceeding claims, wherein the metallic ring protrudes slightly into the bore of the piston to act as an anti-polishing ring on the piston.

13. An cylinder according to any one of the proceeding claims, wherein the coolant passage is helical and progresses around the axis of the cylinder.

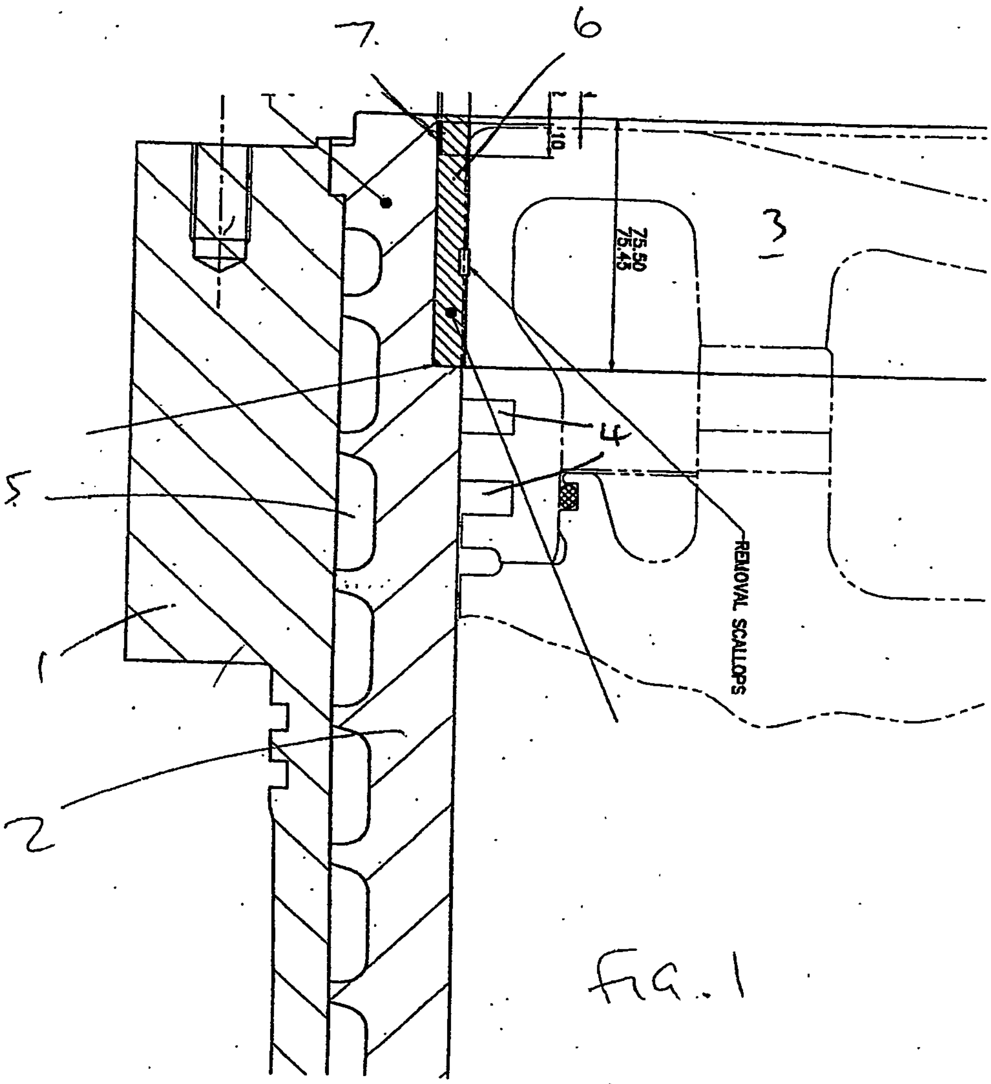

FIG. 1

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